Preliminary Amendment
Applicant: Ronald A. Askeland et al.
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Title: ESTIMATING LOCAL EJECTION CHAMBER TEMPERATURE TO IMPROVE PRINTHEAD PERFORMANCE

IN THE CLAIMS

Please cancel claims 13-20 without prejudice.

Please add new claims 23-30.

Please amend claims 1-5, 7, 9, and 12 as follows:

1. (Currently Amended) ~~A temperature control system for an inkjet printhead assembly, comprising:~~

~~a printhead assembly having ink ejection elements energizable by an electrical pulse having an amplitude and pulse width;~~

~~a sensor coupled to the printhead assembly for generating a signal representative of the printhead temperature;~~

~~a memory device configured to store an optimal operating temperature of the printhead derived from current printhead operating parameters, a thermal response model of the printhead assembly and an ejection history of the ejection elements;~~

~~a controller configured to read a nominal operating pulse width, the signal from the sensor, the optimal operating temperature, the ejection history of the ejection elements and the printhead operating parameters from the memory device for calculating an adjusted pulse width and to create a dynamic estimate of a current temperature distribution across the printhead assembly; and~~

~~a firing controller with an ejection sequence sub-controller configured to dynamically and selectively control the sequence of fire pulses, a firing delay sub-controller for reducing electromagnetic interference in the printhead assembly and a fractional delay sub-controller for compensating for scan axis directionality errors of the printhead assembly~~

A printhead temperature control system, comprising:

a printhead assembly having a plurality of ejection elements;

a temperature sensor configured to generate a measured temperature of the printhead assembly;

a memory device configured to store a thermal response model of the printhead assembly and an ejection history of the ejection elements; and

a controller configured to estimate an actual temperature of the printhead assembly based on the measured temperature of the printhead assembly, the thermal response model of the printhead assembly, and the ejection history of the ejection elements.

2. (Currently Amended) ~~A method of controlling the temperature of an inkjet printhead having ink ejection elements, the method comprising:~~

~~sensing a nominal printhead operating temperature;~~

~~determining an optimal operating temperature of the printhead as a dynamic estimate of a current temperature distribution across the printhead assembly derived from a thermal response model of the printhead, an ejection history of the ink ejection elements and a current printhead operating temperature;~~

~~using the determined optimal operating temperature for controlling the temperature of the printhead and controlling the sequence of fire pulses; and~~

~~reducing electromagnetic interference in the printhead assembly and compensating for scan axis directionality errors of the printhead assembly with a firing controller~~

A method of controlling a temperature of a printhead having a plurality of ejection elements, the method comprising:

sensing a current printhead operating temperature with a sensor on the printhead; and

estimating an actual printhead operating temperature based on a thermal response model of the printhead, an ejection history of the ejection elements, and the current printhead operating temperature.

3. (Currently Amended) The temperature control system of claim 1 wherein the controller is located on at least one of the printhead assembly ~~or externally on~~ and a printer associated with the printhead assembly.

4. (Currently Amended) The temperature control system of claim ~~1~~ 25 wherein the controller reads the ~~nominal operating~~ pulse width and pulse width calibration data from a memory located on the printhead assembly.

5. (Currently Amended) The temperature control system of claim ~~1~~ 25 wherein the controller reads the ~~nominal operating~~ pulse width and pulse width calibration data from a memory located on ~~the~~ a printer associated with the printhead assembly.

6. (Previously Presented) The temperature control system of claim 1 wherein the temperature sensor is an analog temperature sensor.

7. (Currently Amended) The temperature control system of claim 6 further including an analog to digital converter for generating a digital format ~~of the measured analog signal~~ from the analog temperature sensor.

8. (Previously Presented) The temperature control system of claim 1 wherein the temperature sensor is a digital temperature sensor.

9. (Currently Amended) The temperature control system of claim 1 wherein the temperature sensor includes multiple temperature sensors distributed around the printhead assembly ~~so as to provide a global measurement of the printhead temperature~~.

10. (Previously Presented) The temperature control system of claim 4 wherein the pulse width calibration data is in the form of an equation.

11. (Previously Presented) The temperature control system of claim 4 wherein the pulse width calibration data is in a look-up table.

12. (Currently Amended) ~~A method of controlling the temperature of an inkjet printhead having ink ejection elements energizable by an electrical pulse having an amplitude and pulse width, comprising:~~

~~reading a nominal printhead operating temperature, a nominal operating pulse width and pulse width calibration data;~~

~~determining an optimal operating temperature of the printhead as a dynamic estimate of a current temperature distribution across the printhead assembly derived from a thermal~~

~~response model of the printhead, an ejection history of the ink ejection elements and a current printhead operating temperature;~~

~~determining a pulse width adjustment factor based on the pulse width calibration data, the optimal operating temperature and the measured temperature of the printhead;~~

~~calculating an adjusted operating pulse width based on the pulse width adjustment factor and the nominal operating pulse width;~~

~~applying the adjusted operating pulse width to the printhead to control printhead temperature; and~~

~~controlling the sequence of fire pulses, reducing electromagnetic interference in the printhead assembly and compensating for scan axis directionality errors of the printhead assembly with a firing controller~~

A method of controlling a temperature of a printhead having a plurality of ejection elements energizable by an electrical pulse having an amplitude and a pulse width, the method comprising:

obtaining current operating parameters of the printhead and a current operating temperature of the printhead;

determining an estimated actual operating temperature of the printhead based on a thermal response model of the printhead, the current operating temperature of the printhead, and the current operating parameters of the printhead, including an ejection history of the ejection elements;

calculating an adjusted pulse width based on pulse width calibration data for the printhead, the current operating parameters of the printhead, and the estimated actual operating temperature of the printhead; and

applying the adjusted pulse width to the printhead to control printhead temperature.

13-20. (Cancelled)

21. (Previously Presented) The method of controlling the temperature of claim 12 wherein the pulse width calibration data is in the form of an equation.

22. (Previously Presented) The method of controlling the temperature of claim 12 wherein the pulse width calibration data is in a look-up table.

23. (New) The temperature control system of claim 1 wherein the ejection history of the ejection elements identifies whether the ejection elements have been fired and whether the ejection elements have not been fired.

24. (New) The temperature control system of claim 23 wherein the thermal response model of the printhead assembly includes a first set of parameters when the ejection elements have been fired and a second set of parameters when the ejection elements have not been fired.

25. (New) The temperature control system of claim 1 wherein the ejection elements are energizable by an electrical pulse having an amplitude and a pulse width, wherein the memory device is configured to store an optimal operating temperature of the printhead assembly, and wherein the controller is configured to adjust the pulse width based on the optimal operating temperature of the printhead assembly and the estimate of the actual temperature of the printhead assembly.

26. (New) The method of claim 2 wherein the ejection history of the ejection elements identifies whether the ejection elements have been fired and whether the ejection elements have not been fired.

27. (New) The method of claim 26 wherein the thermal response model of the printhead includes a first set of parameters when the ejection elements have been fired and a second set of parameters when the ejection elements have not been fired.

28. (New) The method of claim 2 further comprising:

energizing the ejection elements with an electrical pulse having an amplitude and a pulse width; and

adjusting the pulse width based on an optimal operating temperature of the printhead and the estimate of the actual printhead operating temperature.

29. (New) The method of controlling the temperature of claim 12 wherein the ejection history of the ejection elements identifies whether the ejection elements have been fired and whether the ejection elements have not been fired.

30. (New) The method of controlling the temperature of claim 29 wherein the thermal response model of the printhead includes a first set of parameters when the ejection elements have been fired and a second set of parameters when the ejection elements have not been fired.